Chapter IX

SURVIVAL AND ACCEPTANCE

THE LUKASIK YEARS: 1971-1974

The Setting - 1970

Dr. Stephen J. Lukasik was appointed Director of ARPA in January 1971 and was to serve in that post until January 1975. His tenure is the longest of the ARPA Directors -- counting his service as de facto Director during 1970 while Dr. Rechtin was doubling as a Deputy Director of Defense Research and Engineering, Lukasik was on the job for five years. There had been no outside search for a new Director. To Rechtin and Foster, Lukasik was the obvious candidate to carry on the reshaping of ARPA that the DDR&E wanted.

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Despite the Nixon Administration's gradual "de-escalation" of the conflict, however, many Vietnam issues were still quite explosive. The My Lai massacre, for example, drew headlines throughout much of the year, amid charges of extensive Army cover-ups. Sihanouk was overthrown in Cambodia, followed by the massive South Vietnamese-American incursion into that country, which in turn occasioned a storm of domestic protest. The Kent State student shooting episode took place in May, followed by widespread university closings for memorial services and anti-war demonstrations. Later in the year the Army Mathematics Research Center at the University of Wisconsin was bombed, resulting in one fatality and extensive damage to the facility. Bombing raids on North Vietnam continued to inspire protests. The Senate Foreign Relations Committee remained a high visibility focal point for criticism of Vietnam policy.

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airline highjackings* and clashes between Palestinian terrorists and the government of Jordan.

Though the ARPA setting still was dominated by the continuing Vietnam conflict, the atmosphere was quite different from 1965 when massive U. S. involvement and campus-based protest were very new. War weariness had definitely set in and overwhelming pressures toward withdrawal had begun to take effect.

Lukasik's View of the ARPA Role

Dr. Lukasik, as previously noted, had been with the Agency since 1966 when he joined as head of the VELA office. He had thus witnessed the successes and set-backs of the Herzfeld period, ARPA's troubles with DDR&E, and the effects on the Agency of national policy decisions with respect to missile defense and the Vietnam War. He had also served as Acting Deputy to Dr. Franken and observed the demise of the view that ARPA should encourage academically-oriented basic research with only a broad justification of defense relevance. As Deputy to Rechtin, Lukasik could see the great difficulties involved in identifying and establishing new "revolutionary" projects and in achieving clear cut transfer successes of the type desired by the former Director. He had also, of course, lived through the Agency's AGILE and Vietnam traumas, the Mansfield Amendment restrictions on Defense research, and the many other disputes of the late 1960's.

A physicist with some administrative experience at the Stevens Institute of Technology prior to coming to ARPA, Lukasik became immersed in ARPA's internal management throughout his nine year tenure. Franken had been overtly uninterested in detailed management and had numerous clashes with Lukasik on this account; Rechtin tended to be deeply involved in ARPA's external affairs and in specific projects that interested him personally or demanded attention in the crisis atmosphere of the times. Considerable internal management responsibility consequently devolved upon the Deputy Director. Rechtin says that in his last year as Director, Lukasik gradually assumed almost all of the day-to-day responsibilities for ARPA management.[2] Perhaps because of these responsibilities, as well as personal proclivities, Lukasik was to be far and away the most introspective of the long chain of ARPA Directors in terms of his attention to ARPA's internal affairs. His meticulous concern with office organization, personnel, and budgetary and administrative issues was remarkably different from the approaches of all his predecessors.

As he assumed office Lukasik was, of course, very much aware of the morale problems on the ARPA staff in 1970-1971. He recalls the atmosphere surrounding the transfer of ARPA from the Pentagon to Rosslyn:[3]

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* Two officials of the ARPA field office in Thailand were, incidentally, among passengers held hostage in Jordon after these events. They were released unharmed after a period of substantial Agency concern.

> [There were] terrible feelings that this is the end.... [W]hile I was not in the alarmist camp, even I felt -- and I probably had a better view of what the issues were than anyone else -- even I felt that this was the beginning of the end.

Later Lukasik believes that he was able to turn the move to ARPA's advantage. Instead of harming the Agency, he believes that it removed ARPA from distractions, eliminated the Agency from the bickering over space in the Pentagon, enabled it to concentrate on its programs, supported the low profile image that he and Rechtin desired, and helped to solidify a feeling of identity:[4]

> It turned out to be one of the best things that ever happened to ARPA because, in fact, it was probably critical to ... whatever I accomplished.... [W]e stayed off and tended to our business.... In fact, it meant that almost all meetings in ARPA automatically became more efficient because if someone took the trouble to climb in a car and come all the way over to Rosslyn and have a meeting with you, it must have been something important and useful.... [At Rosslyn there was better space, circulation, etc.] So the building lent itself to communication.... Basically the move strengthened the internal feeling of identity.

Like his predecessors, Dr. Lukasik was inclined to take a strong view of the rightful status of the Agency. Asked why he took the job, Lukasik responded:[5]

> Because it [ARPA] was in trouble ... it was something that required change and could be changed. [The ARPA Directorship] is probably the best job in Washington for a scientist -- more prestige than NBS or NSF.

He conceived of himself as striking "the mean" between the ARPA's of Herzfeld and Rechtin. Lukasik was deeply committed, for instance, to Rechtin's principles of maintaining a low profile for the Agency and insisting on program transfer to the Services. On the other hand, he was just as deeply opposed to the office "barony" mode of operation and the involvement of the Director in the day-to-day details of individual projects. He was also more sympathetic to basic research and was less inclined than his immediate predecessor to make program transfers in large chunks, but the difference was more a matter of degree than of substance.

Lukasik firmly believed that ARPA's work was of first order importance; however, given the chain of events that had taken place since 1966, his approach to resurrecting a strong ARPA role was laden with defensive overtones. Lukasik may typically be seen as struggling to salvage a faltering effort in one office; gracefully (or sometimes abruptly) to cut losses in another; unobtrusively to grow a new program from modest beginnings; and to compromise with outside pressures (even at the expense of program flexibility) in order to avoid larger conflicts, or even just preserve some symbolic sign of ARPA's status.* For the new Director, the road to a strong ARPA was thus a winding one, requiring considerable ability to maneuver. Like Rechtin, he received no specific instructions from the DDR&E about how to administer ARPA, but he felt that he and Foster "resonated well" together, probably because both were physicists and had nuclear and weapons laboratory backgrounds and common professional acquaintances. Although the Herzfeld era "treaties" with ODDR&E were now forgotten, the management-conscious Lukasik became worried about the formal legitimacy of ARPA's tasks because of the cumulative pressure of GAO audits, Congressional inquiries, etc. He felt constantly badgered by "why ARPA?" questions and "who told you to do that?" criticisms. A hurried review suggested that about one-third of ARPA's projects had no known charter and others were informally justified at best. Perhaps over-reacting in the quest for "legality," Lukasik decided to use the old ARPA model: ARPA drafts a charter, DDR&E coordinates and the Secretary of Defense signs off. Six sample charters were submitted to Foster, who personally rewrote them. The thrust of his revisions was to narrow them and to express the philosophy that whatever ARPA was doing was <u>unique</u>, i.e., was not being done anywhere else in DOD. In Lukasik's mind, this was the "kiss of death" because uniqueness is so incredibly hard to prove. He dropped the whole charters exercise and the DDR&E never mentioned it again.[6]

While conditions never posed an immediate threat to ARPA's existence during Lukasik's leadership, he was clearly mindful of that problem. This probably helps to explain why brash statements of ARPA principles were less evident and less influential in guiding the ARPA program of the 1970's than were pragmatic adjustments to the Agency's difficult bureaucratic surroundings.

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*A trivial, but somewhat indicative, early example of Lukasik's concern with ARPA's status comes from a peer's recounting of his resistance in 1967 to Dr. Franken's thought of giving up the American flag in the Director's office, for reasons of decor. An official flag was assigned to ARPA in the Roy Johnson period when the ARPA Director's position was Executive Level III. The flag was retained when the position was later reduced to Executive Level IV. Lukasik reportedly felt that if once given up, it could never be regained. The story goes that when Franken checked the flag closely he saw that it indeed bore the 48 stars of 1958 and decided to retain this symbol of past status.

A very low profile posture for ARPA, "lest you get killed," was de rigueur for Lukasik's ARPA. He believed that it was folly to try to compete with ODDR&E as a center of expertise or as a technological spokesman. Likewise, highly visible assertions of independence courted Service attacks and complicated the transfer process. His belief in program transfer was related to this position: "I believe in transfer above all else, except survival."[7]

It was better to have transfer successes than to have credit for an idea, because as long as an idea remained in ARPA it was of no use. On the other hand, it was better to cement key Agency relationships than to push for a project transfer if the process of transfer could be damaging to ARPA, i.e., if there was reluctance on the part of the intended recipient to accept the proposed transfer. Lukasik was extremely aggressive in pursuing close Service connections for ARPA, especially with operational types, whom he felt had a much greater potential interest in ARPA than did Service R&D units. Moreover he believed that the operational military and the JCS would be likely to raise fresh, important problem areas that ARPA would otherwise overlook or not hear about:[8]

> I used to like to go to military locations because I really wanted to hang out with the military. Particularly the operational military. I avoided the military R&D people like the plague. Because they were guys just like me. Whether they were civilian or military they were just like me. [And] they weren't as good as ARPA. So, I tended to avoid the military R&D. But I liked to get out into [the field].

He felt that ARPA's "world" was really the world of OSD, JCS and the unified commands, all of which he describes collectively as "non-Service outfits." The commands, in particular, understood multi-Service needs and were most anxious for help. Lukasik courted them and believes that ARPA developed a sound record of response in meeting their requests. It is ironic too that Dr. Killian recalls that at the time of ARPA's creation, the science elite and others at the White House believed that the then brand new unified commands would need an organization like ARPA to meet their needs.[9] Dr. Lukasik cites the impact of some work undertaken for a command, at the request of the commanding Admiral:[10]

> [B]y the time ARPA finished it, he was Vice CNO, and I will also remember, with a feeling of 'having arrived,' when I received a letter from the Vice CNO explaining to me how the Navy was implementing 21 of ARPA's 22 recommendations and explaining rather apologetically when they couldn't accept the 22nd. You know, that's the way we got it, ... dropping in and out [of the commands]. So

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continued description of ARPA as the Defense Department's "anti-surprise" agency, with frequent reference to Sputnik and the need to avoid similar occurrences in the future. In fact, however, this rationale for ARPA's role appears to have been as much repeated out of habit and tradition as anything else. Dr. Lukasik's personal view on this question is revealing:[14]

> Well, if you read some of my earlier statements you would put me in the guarding against technological surprise school of thought. I found that that was an idea that did not wear very well. I said it a lot. I probably said it on my way out of ARPA, but I was really believing it less and less.... [Actually] I don't think that's a particularly important factor.... In the first place, nobody likes to be surprised, but surprise rarely hurts you.... You're at worse discomforted. Probably the prime example is the Soviet satellite; good case of technological surprise. [But] you know, in three years or four years we caught up and now we are preeminent in space. You may be surprised and surprise means that you may have to sweat a bit, run a bit and spend some extra money. But, rarely can a major power overcome another major power within the relatively short time that a surprise gives you, because if someone pulls off surprises -- another major power can catch up quickly in two, three, four, five years. You can't change international power balances in that time period. So, the way I finally came out is, 'surprise is uncomfortable but rarely, if ever, fatal.'

Dr. Lukasik's amplification of this view resurrects memories of the perspectives of Dr. Ruina and perhaps also Dr. Killian and the science advisors of the late 1950's and early 1960's. His interpretation is that to the extent "avoiding technological surprise" is meaningful it is in terms of keeping the nation on the forefront of militarily-relevant advanced technology, so that key policy decisions vis-a-vis military technology will be made from a solid base of knowledge. To illustrate:[15]

> Surprise ... is a measure of a difference in perception between two countries' technologists. One who not only thinks he can do it, but is in the process of doing it. The other who thinks you can't do it, because according to their technology, it's just not in the cards. Now ... the closest I can come to ARPA as an agency to avoid technological surprise, would be rephrased this way:

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> ARPA is an agency that keeps this country at the forefront of as many areas of technology as are likely to be militarily relevant. So that if there's any judgment to be made in this country about the possibility of a state of technology, we will not be dealing out of weakness as our space scientists were in the late '50's, when they were sort of saying, 'well, you can do it, but we don't know what it's worth and it's pretty expensive, and so on.' So that's why we are pushing everything from lasers, to materials, to computers, to space technology, to -- you name it -- and pushing all these areas. So if there are any judgments to be made, our guys are not going to make the wrong technological judgments as to the possibilities.... To that extent ARPA is avoiding technological surprise, but that doesn't necessarily mean we have to do everything, that we have to do everything that's possible, that we have to do everything first. It's the weak form of avoiding technological surprise. It's what I would perhaps call avoiding technology perception gaps.

Dr. Lukasik went on to state that there should ideally be some mechanism or system to keep the ARPA Director aware of the status and potential of militarily-relevant technologies, so as to give him a more formal method of determining which advanced areas were most deserving of ARPA support. Ideally, as he put it, "We wanted to understand the limits of every bit of technology that would be relevant."[16] Despite the fact that such a mechanism does not exist, it is clear that Lukasik views ARPA's strength and mission as the selection and timely support of critical areas of technology (across the broad front of basic and applied research and exploratory development) and not really as preventing Sputnik debacles, the legend of ARPA's creation notwithstanding.

While using much of the old terminology and defending ARPA's importance, Lukasik also was forced to face up to the basic fact that the ARPA program was no longer dominated by so-called "Presidential issues," with major blocks of funding devoted to single large problems such as advanced ballistic missile defense, nuclear test detection, or even counterinsurgency. Both Rectin and Lukasik admit that their directorships did not really have such "Presidential issues." Portions of the old problem areas still retained no longer were of first rank priority for the Secretary of Defense or the White House and there was no momentum to mount multimillion dollar attacks

on new problems of similar stature.* In Lukasik's perspective, the decline in Presidential issues indicates not that ARPA failed in any important respect, but merely illustrates that no technically-oriented agency can expect to have a continuing flow of major assignments on subjects that dominate the concerns of Presidents and Secretaries of Defense. National policy debates, that is, only occasionally hinge on developments in advanced technology which call for urgent, concerted programs, and when such debates arise they are only sometimes within the area of responsibility of the Department of Defense, e.g., the energy crisis may call for urgent advanced technology programs, but the mission does not primarily lie with the Department of Defense. Lukasik, therefore, rejects the concept that ARPA can realistically be organized around matters of Presidential importance. Dr. York, for instance, maintains that he was the most powerful of the DDR&E's because when he assumed office in 1959 most major national security issues were being defined primarily as technological issues.[17] This no longer is the case.

With the decline of Presidential issues, Lukasik turned to the somewhat less structured notion of monitoring developments generally in advanced technology as providing the basic rationale for an ARPA. As cited earlier, he described ARPA as keeping the country "at the forefront of as many areas of technology as are likely to be militarily relevant." To fill this broader role, the Lukasik ARPA becomes more diffuse and individual program elements become smaller, are less closely integrated with major missions, and cover a wider scope of activities. This trend is well illustrated by the preeminence of the Strategic Technology and Tactical Technology offices of the Lukasik ARPA, which were bounded neither by a specific technology nor a concrete mission objective and more or less divided equally between them the mainstream military functions of the Department of Defense to which technology could contribute. The remaining technology-defined offices (human resources, materials, information processing) may be regarded almost as "support" offices to the two large elements oriented more directly toward technological enhancement of tactical and strategic capabilities.** The greater diffusion of the ARPA effort and concentration on smaller discrete program elements in the Lukasik period naturally meant that the impact of

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* The closest thing to this in the Rechtin-Lukasik period is probably the sizeable effort organized around the issues of antisubmarine warfare and maintaining the underseas deterrent. While this is a very significant DOD problem, it has not generated the kind of national policy debate that the earlier major assignments did and ARPA's role is less independent and is more closely integrated with multiple Service and other agency efforts.

** In fact, their amalgamation into a more general Supporting Research office was raised as a possibility during deliberations on ARPA's internal organization during the Lukasik period.

any given program element was likely to be less far-reaching than that aspired to by the larger "big problem"-oriented programs of the past. In the words of one of Lukasik's office directors, ARPA came to focus on problems where a successful effort might be "sort of crucial,"[18] a distinct moderation of earlier claims.

It can be argued, however, that the cumulative importance of these multiple, smaller programs can be equal to or greater than that of a few larger-scale attacks on first-order DOD problems. Given the Lukasik view that the flow of legitimate "big" technological problems is discontinous, and hence efforts to organize advance research around such problems would often be artificial, the more diffuse pattern of support for moderate-scale efforts on relevant Defense problems might appear to be much more effective. The question to be addressed about the Lukasik period, however, is whether, even if this approach is more realistic, it did not seriously reduce the Agency's ability to put a "critical mass" of support behind a new technology, lessen its ability to be innovative by tying it too closely to immediate Service problems, and generally to undercut the uniqueness of the ARPA approach.

To summarize Lukasik's view of the ARPA role, its major tenet appears to have been that for ARPA to be effective it had to establish a broad base of acceptance across its spectrum of Defense and Service customers. Acceptance might range from positive support and pro-ARPA advocacy to passive toleration, but broad acceptance of the Agency in many quarters was essential. Stripped of clear-cut charters which could be thrown in the face of a hostile bureaucracy and decreasingly utilized by ODDR&E as a direct challenge to the Services (as ODDR&E moved toward a more coordinative mode of operation), carefully cultivated relationships across the DOD establishment provided an alternative foundation for a workable ARPA. To this end, the ARPA philosophy -- or, rather, its succession of compatible and conflicting philosophies -- had to be adjusted, modified and presented in a variety of fashions acceptable to a diverse Congressional, OSD and Service clientele. In Lukasik's eyes, this development of a new foundation for ARPA (in many respects a prolonged exercise in bureaucratic politics and public relations) was not contradictory to the essence of the ARPA concept. If ARPA could remain on the forefront of Defense-relevant technological change, retain substantial flexibility to investigate high-risk and or overlooked technical problems, and sustain a commitment to research quality -- then it could tolerate restrictions inherent in its new mode of operation. What would be lost in the no longer sustainable appeal to Presidential Issue charters and the mystique of quasi-independent authorities would be compensated for by the protection and opportunities offered by multiple customers for the ARPA program. To a remarkable extent, given the depths of the ARPA crisis of the late 1960's, Lukasik succeeded in creating this broad foundation of Agency acceptance.

Support for Basic Research

Lukasik sensed the apparent contradiction between defense relevance and transfer on the one hand and "high-risk, high-payoff" R&D on the other. In an effort to reconcile these viewpoints, he reintroduced the notion of defense relevant basic research so common in the early ARPA and conceded that basic and applied research (6.1) was the most likely source of revolutionary or breakthrough ideas:[19]

> You are more likely to find the breakthroughs in 6.1 than in 6.2 because 6.2, by definition, [is] exploring issues that are more or less defined; you know, working with existing technology to see what they will do, and pushing them. And so the breakthroughs are going to be in the 6.1's. In materials we look for polywater because that would have been a super-duper kind of new material. We looked for room temperature organic superconductors because that would have been a super thing to do. We looked for new computer languages and artificial intelligence because that's going to do wonderful things like enabling computers to understand speech.... Those are all probing for breakthroughs. There are probably more breakthroughs per dollar to be found in 6.1 than in 6.2 and that's one of the reasons why you will never, or at least never should, reduce 6.1 to zero....

Having said that, Lukasik adds the companion conclusion that the 6.2 exploratory development work will have a much higher percentage of successes than 6.1 efforts. Therefore it makes more sense to emphasize 6.2 work: "I don't believe we were in the breakthrough business, really. You know, breakthroughs are important and you ought to invest to find them, but I don't think that's the name of the game at all."[20] Accordingly his rough rule of thumb was a ratio of about 80 per cent 6.2 work to 20 per cent 6.1.*

Given this outlook, it follows that Lukasik did not believe that DOD, as the largest user of scientific information, had some sort of moral obligation to support basic research:[21]

> I never bought that argument. I never bought it then [in the late 1950's and early 1960's] and I don't think I would buy it now. For one reason,

* As with Lukasik's desired rate of project turnover this was roughly in accord with historical practice.

> it has zero sales value on the Hill because the Hill takes a very simple-minded -- that doesn't mean wrong -- approach. They like ... a fairly neat, orderly Executive Branch. When they want to buy defense, they go to the Defense Department, when they want to buy natural resources, they go to the Interior Department, and if they want to buy science, they go to the Science Department. And so to tell them that the Defense Department is a user of science and it ought to put some of its defense dollars into replenishing the bank that it has been drawing from, the Congressional attitude -- not unreasonably is -- 'no, when we want to replenish the bank we'll give it to the Science Department and they'll replenish the bank....' So I think that replenishing the bank, that was a great argument in the late '40's and '50's, the sort of golden age of science. You know, we were still basking in the way science won World War II. The Defense Department was really the National Science Foundation of the country. The Defense Department had a very sensible approach to the support of science.... [Then] that was a great argument. [But] by 1970 it had zero sales potential on the Hill.... [There was] now a science department [NSF] that replenished the science bank....

Thus, for ARPA to support basic research there must not only be "good science" and perhaps breakthrough potential, but also defense relevance:[22]

> I really believe that the reason why you can't leave certain defense science up to the NSF, is the NSF is going to pick its priorities on the basis of science and it may turn out ... that the defense [problem] is ninth on that list, and it may be a first-rank for defense.... [Basic research] can be mission-relevant basic research and that's the essential point.

Determining defense relevance is, Lukasik admitted, a difficult judgment. On the one hand, the scientist searching for support is tempted to try to tie everything to some remote defense need, and on the other hand, some of the apparently most remote things ultimately turn out to be highly relevant. Given budgetary constraints, however, ARPA's criteria for relevance have had to be tightened. Lukasik's expression of this dilemma and ARPA trends in this regard is as follows:[23]

> There are too many, I think, shady scientists; that is, dishonest scientists, who will ... say, 'you've got your submarines in the ocean, and I've got my plankton in the ocean, so give me some money [to study plankton] ... and that's just not reasonable.... [But] there is such a thing as being too smart. There is such a thing as being too clever. There is such a thing as having too much confidence, and, you know, we just may find out that the way to find submarines is to ask the plankton! And ... we may be missing something. And I worried about being too clever, about being too much of a manager. By, you know, planning things and excluding some things on the basis or my own understanding or some expert's understanding. But, when money is tight you're kind of forced into that. And if you have an extra $50 or $60 million you begin to pick up plankton enthusiasts and things like that ... [which ARPA tended to do] ... we were buying all those flaky ideas, because we were too busy to sort them out. So, you know, when in doubt, if you have the money, buy it. When the money got tight you began to think and you just didn't buy a lot of things.

While budgetary limitations restricted the areas of basic research which ARPA could support, Dr. Lukasik felt that the agency was still able to provide institutional support to key organizations. The difference between the early ARPA policy on this issue and Lukasik's, however, lay in the need to satisfy more relevance criteria:[24]

> ... Scientists do not have a right to support in this country. You know, they have a right to live, they have a right to free speech, they have a right to a lot of things, but they don't have a right to the taxpayer's money. At least they don't have a right to the Defense Department's money.... So, yes, I want to build institutions, but I want to build the right kind of institutions.... [For example] if we wanted to build an institution that would improve the quality of intelligence analysis, not an institution in computer science, I [would] begin to get a little bit fussy [about applications] ... you just don't drop a million dollars on the table and say, 'when that's all gone, let me know, and I'll throw another $1 million on the table.' That's not only mismanagement, that's non-management.

Not surprisingly, given this perspective, Lukasik was not a believer in the "block funding" mode of institutional support that was used to underwrite the IDL's, though he professes appreciation for the reasons why this role was earlier accepted by ARPA. Moreover the "institutions" he chose to support usually were organizations like RAND, Lincoln and IDA rather than universities, and the work in those places seldom would be described as basic research.

Perhaps the most interesting aspect of Lukasik's description of ARPA's role in supporting basic research is that it highlights the extent to which issues concerning the level and form of support to basic research are so highly judgmental. Lukasik claims to support institution-building and recognizes that it is difficult to determine the potential utility of many basic research ideas, while insisting that relevance criteria have to be established. The criteria for what is relevant, however, seem to be largely dependent on current budgetary pressures and Congressional attitudes, so that much of what might have been judged as relevant and important, say, in Dr. Ruina's period might be totally unacceptable for ARPA support in Dr. Lukasik's period.

Management Philosophy

Lukasik, as noted, devoted a tremendous amount of time to questions of management structure and performance. At one point he rather forcefully solicited suggestions for organizational change from the ARPA staff, requiring formal papers on the subject from his office directors and convening them in a two day meeting to hear them discuss what they had written. He was sensitive to inherited morale problems and also to the baronial tradition of independent office directors. In his view ARPA was full of "independent baronies" which "had to be broken down" in order to institute proper management control.

While this may appear to be an overstatement, there is more than a grain of truth in it. The tradition of relative independence among office directors goes back at least to the Ruina period, when individuals like Herzfeld, Licklider and Godel exerted profound influence on the shape and direction of their respective program offices. This tradition of independence was strengthened through the years by the fact that successive Directors were inclined, or forced by circumstances, to give their primary attention to a few programs of immediate concern and to delegate large responsibilities to their office directors. This practice may have grown out of control in the last year of Rechtin's tenure -- the period of "absentee ownership" -- when Rechtin was increasingly occupied with his ODDR&E responsibilities and ARPA's office directors had unusually wide latitude to operate on their own. The "one on one" style of management, which Rechtin preferred, was definitely stressed in those circumstances. Lukasik felt that some of the Rechtin era office heads had too much freedom and when he

was elevated to the directorship, some of them tried to perpetuate their status. He was critical of the abilities of a few senior people and, of course, most of the office directors were former peers, a condition that tends to highlight personal rivalries.

To illustrate that there was something to Lukasik's characterization of the baronial tradition, it is appropriate to cite the management philosophy of one of his office director contemporaries.[25] The way to start new initiatives, he stated, was to put "seed money" into established projects and quietly attempt to get something started without the approval of anyone in ARPA, DDR&E or elsewhere. If the initiative proved unproductive, it could be silently "deep-sixed;" if productive, it could be presented for approval as a kind of fait accompli. This office director felt that he had in the above an "investment strategy" which worked "despite" the ARPA Directors and DDR&E, to assure a continuously productive program of value to DOD and to the country. In his view, roles and missions conflicts in DOD (often complicated by Congressional attitudes) depressed new initiatives and the ARPA Directors were overly sensitive to these conflicts. Thus to live up to ARPA's role in taking risks, it was necessary to "bury" initiatives until they were viable and to "hide them from the Director of ARPA."

Lukasik was keenly aware of this aspect of his inheritance. It was another reason for his singleminded attention to matters of organization and management. And to illustrate the depth of the Director's feelings on this issue, he deliberately chose not to staff his new Technology Assessments office -- a small in-house think tank -- with strong idea men. Their purpose was to flesh out the Director's ideas, not promote their own.*

As part of the campaign to break down the baronies and assert control, Lukasik took a highly detailed interest in ARPA personnel policy. For instance, he personally conducted recruitment interviews for all staff rated at GS-12 and above, held entrance-on-duty interviews after hiring, and attempted to hold exit interviews whenever possible. He held rigorous twice annual personnel reviews and enunciated a belief in the value of relatively rapid staff turnover. While believing that "ARPA is a lightning rod and attracts lightning bolts," meaning very high quality personnel, it was Lukasik's philosophy that "the last thing ARPA needs is for a guy to stay, even a brilliant guy, because each has a limited repertoire."[26] As with each ARPA Director, Lukasik believed that getting good people was a priority task. Good people have good ideas and in turn attract programs and funds. With such people, the ARPA Director merely "blocks for his people; he doesn't drive, he blocks."[27] Even so, he felt that an ARPA

* Dr. Lukasik felt that this office was relatively ineffective in its intended role of starting-up new ideas and spinning them off to the established program offices, in part because it was very small and in part because it became a transitional "home" for ARPA staff in need of a billet.

program manager should have the same average tenure as the ideal average program lifetime, namely, about five years or less, because even the best people tend to repeat themselves. This turnover rationale was also helpful in speeding the departure of people in areas where the new Director sought to make changes. The reviews and interviews provided a means through which Lukasik could express his personal views on program needs, staff requirements, etc. and could establish his own authority should potential staff conflicts later arise. He estimated that he spent about one-fourth of his time on personnel matters.

Another Lukasik management control device was the requirement for a weekly report from each office director (a procedure instituted by Rechtin) and bi-weekly meetings with office directors and key staff. These reports and meetings were intended to be highly substantive, highlighting, for example, scientific advances, key upcoming meetings, the outcome of study groups, developments under specific contracts, etc. And Lukasik asserts that he "used to run through ARPA and just sit in people's offices and talk to them," and that his own door was always open in an effort to increase cohesiveness.[28]

Lukasik's overall management approach is perhaps best illustrated by the following statement:[29]

> [T]he key to command and control is, in fact, communication, because if there is good communication, that means you know what's going on. If you don't like it, you can stop it. If it's not what you wanted, you can correct it. They, in turn, are communicating with you so that if you are about to give a wrong order, they correct you in your misapprehension or your misperception of the situation. And you always know what the situation is, and therefore what needs are in order.

The Lukasik management approach emphasized the authority of the Director and his involvement in all key decisions, despite an alleged interest in recruiting strong, highly-qualified personnel. Though Lukasik claims that "every ARPA guy is a star" and that he "just blocked" for his people, he in fact appears much less inclined to delegate significant authority than almost all of his predecessors, and this fact is reflected in the style and operation of ARPA in the early 1970's.

Organizational Structure. The brief remarks above on changes in organizational arrangements noted the move to consolidate STO and create TTO, along with some supporting offices, symbolizing the general thrust toward discrete projects within offices with very broad functional titles. These

moves also contributed to Lukasik's objectives in exerting control over the Agency, breaking down the baronies, and protecting it against abrupt "chunk-type" transfers or program cancellations.

Not only were Presidential issues gone, but Lukasik believed they actually had an unhealthy effect on the organization. He criticized "the crazy assumption built into ARPA" that "assignments came down from on high and you organized a new shop to do it."[30] This procedure resulted in baronies, in large, ultimately vulnerable programs, and in reduced flexibility for the ARPA Director to move his people around.

By slimming programs down to "bite size" and devising an organizational structure that tended to disguise or obfuscate who was doing what, it was possible to enhance internal control and reduce external vulnerability, i.e., to serve as a "survival recipe." The creation of relatively small, new program elements is often more successful than requesting increased funding in old ones, since Congress rarely increases an existing program element (though it may cut it). In addition, in the Lukasik structure the program elements could be handled almost any place, and he sought through a concept called "matrix management" to use people in different offices on a team basis, or to take advantage of special skills wherever they might be found. One man, for instance, might manage or coordinate all Navy-related work in ARPA, regardless of the offices in which it was located. To further enhance survivability, each 6.1 office was required to take blocks of 6.2 work, e.g., Behavioral Sciences was held at a $4 million ceiling for its basic research, but was permitted to add some $6 million in a 6.2 program element called Teaching, Forecasting and Decision Technology.

The net effect of this organizational approach was to maintain a low profile ARPA, emphasizing relevance and transfer, while giving little appearance of major change, i.e., just a "plain vanilla ARPA."[31]

Budgets. Part of Lukasik's mechanism for program control was dictated by outside requirements. Undoubtedly the most demanding of these were the three times a year budget reviews required by the annual funding cycle. As Congressional desires for presentations of greater detail increased (a general trend in the late 1960's and early 1970's), these budgetary reviews became even more thorough and time-consuming. To illustrate the extent of change, Ruina, Sproull or Herzfeld would come to the House Appropriations Committee (and other committees) with a budget request for $X million for VELA, $X million for DEFENDER, etc. Specific programs would, of course, be discussed in the ensuing testimony, but often not in detail, and usually without regard to funding history. Details were available on request, often in the form of subsequent transmittals for the record, but were not routinely volunteered. During Dr. Lukasik's directorship, in contrast, lengthy formal submissions were placed in the record as standard procedure. They would include a detailed description of each major program element, sometimes

covering funding blocks of less than $1 million. The description would include statements on objectives, accomplishments, major contractors, related programs, program content over a three year period (last, current, and year requested), and other points. The internal budgetary reviews leading to the preparation of such submissions thus came to be very thorough exercises and permitted the ARPA Director to read into the details of program development much more readily than in earlier years.

Budgets were very tight during the Lukasik era, hovering around $200 million (See Figure IX-1). Belt tightening was in order and Lukasik was very adept at doing it, at a price, however, of "mortgaging the future." Various steps were taken to save what were felt to be good programs and to keep the real ARPA budget somewhat above actual appropriations. Among the techniques used were the following: (1) reducing unobligated balances gradually from around $50 million to zero, (2) reducing university forward funding to zero in major programs ($60 million from the IDL's), (3) reducing forward funding for non-university recipients, releasing roughly $100 million, (4) reducing the carry-over at Lincoln Laboratory (perhaps $15 million), and (5) speeding up transfer in selected programs (an estimated $100 million). Taken together these estimates total about $325 million, or roughly a $65 million annual "bonus" spread over a five-year period to be used for new starts and priority programs. Hence the "real" ARPA program during these years was arguably more on the order of $265 million.

As of FY 1975, most of this well had been pumped dry and ARPA's flexibility was severely reduced. Lukasik was able to do this efficiently in part because of his long tenure as Director. Rechtin believes that the post-Lukasik situation is dangerous:[32]

> When I was there we had more money than ideas. By the time Steve [Lukasik] left, the dollar situation was so bad, that they had far more ideas than money. And I [say] 'that's bad'.... So ARPA was in bad financial straits because of what the Congress had done to budgets as a whole, what the inflation had done -- the combination of things -- the real dollars went down. Not good.

In fact, Rechtin sees the seeds of a future crisis in ARPA's existence:[33]

> I don't know whether ARPA is going to be once again subject to the threat of being done in. Because the budget crunch is getting to be so bad now ... it wouldn't surprise me that all of a sudden [a Secretary] would ... decide to 'kill ARPA.'

Lukasik used other means to reduce the impact of declining budgets. For instance, the Services were invited into jointly funded consortia on programs that ARPA previously would have funded alone. This, of course, helps the transfer objective. On the other hand Frosch has suggested that in some programs multiple participants simply slow things down and DOD would be better served if ARPA were given the assignment and the funds to do the whole task.[34] Lukasik also reduced the amount of "high risk" work undertaken and tended less to fund multiple approaches to problems. The effects of these decisions on ARPA cannot be assessed at this time. Lukasik worked at reducing the size of the slush fund provided to the Deputy DDR&E's as well, in part because he felt they were using it primarily for rather pedestrian support services.

Lukasik did not complain about lack of funds. He obviously believed $200 million was too low, but conceded that $300 million would be too high. At the high end of the scale, Lukasik and his Program Management Director, Russell Beard, believe ARPA tends not to be managing well:[35]

> Russ used to say [that] when ARPA came down to the $200 million level we were doing a much better and more professional management job. And he was right. So there is [such a thing as] having too much money. ARPA has had too much money in the past.... But it is true that when you are too constrained, you spend all your time worrying about the best way to lay out $10k here and $20k there, and that misses the point of ARPA.

Reflecting on his years in office, Lukasik concluded that "Basically, what ARPA needed was a little bit more money, not a lot more money."[36] It might be noted in this regard that the amount of contract money managed by a given ARPA program manager has decreased steadily and very substantially over the years. In FY 1963 (Ruina period), for example, there were $3.7 million in contract funds per ARPA professional and in FY 1971 (beginning of Lukasik's tenure) only $1.9 million. Thus ARPA funding would roughly have to double (with staff size held constant) to approximate the dollar management situation of the early 1960's. ARPA tolerated in that era, and was permitted to sustain, a much looser management approach than appeared feasible or desirable to Lukasik in the environment of the 1970's.*

<u>An ARPA Laboratory</u>. Dr. Lukasik was a strong proponent of the position that ARPA should not have its own system of laboratories. As he put it: "ARPA must take a vow of poverty. It must never own anything."[37] Speaking some seventeen years after the decisions not to seek such laboratories

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* In the "glory days" of the space programs there were over $13 million in contract funds per ARPA professional, <u>including</u> the IDA contract staff. Figures cited above include all professional staff; contract dollars per program manager would be significantly higher. Reliable historical data on numbers of professional staff serving as program managers is, however, unavailable.

Figure IX-1

PROGRAM BUDGET HISTORY DURING THE LUKASIK PERIOD
($ millions)

	FY 1971	FY 1972	FY 1973	FY 1974	FY 1975
Appropriations Requests	223	228	227	211	217
Actual Budget	209	210	200	194	202
Commitments to Agents	215	210	na	na	na
Requests By Program:					
Strategic Technology (STO)	66	78	79	73	75
Nuclear Monitoring	35	36	31	21	19
Materials	21	20	18	20	22
Behavioral Sciences/HRRO[1]	6	9	6	9	10
Information Processing/DIS[2]	27	32	39	44[3]	44[3]
Tactical Technology (TTO)	-	-	16	28	36
AGILE/ODR	21	27	-[4]	-	-
Advanced Sensors	23	9	13	8	-[6]
Advanced Engineering	17	18	13	-[5]	-
Technical Studies	8	8	6	4	2
Technology Assessments	-	-	-	-	5
Management Support[7]	-	-	4	4	4

1 Includes 6.1 (human resources research) and 6.2 (training, forecasting and decision technology) components

2 Includes 6.1 (information processing) and 6.2 (distributed information systems) components

3 Includes "advanced command and control and communications technology" element, conducted in conjunction with STO

4 Becomes TTO

5 Merged into TTO

6 Merged into TTO

7 Management support element added when ARPA separated from OSD and becomes a Defense Agency

were made, he regarded this as perhaps "the smartest principle that anyone ever built into ARPA."

The reasons for Lukasik's opposition to laboratories were essentially unchanged from the original rationale given for the decision against such facilities, namely, that they would create an unwieldy logistics tail and reduce the organization's ability to undertake new initiatives. Lukasik's view of the principle of not having an ARPA laboratory was violated in a major way only once. This was in the creation of the Range Measurements Laboratory (RML) at Patrick Air Force Base. While this was nominally a Service facility it was very highly dependent on ARPA funding, and the obligation to continue support became a major burden when the parent ARPA office (Advanced Sensors) was reoriented and finally phased out. The process of withdrawing ARPA funding and encouraging the Air Force to provide continuing support was a painful, drawn-out experience. It was partially because of this experience that a decision was made against the development of a national laser facility during the Rechtin-Lukasik period.

Parenthetically, a number of difficult organizational problems during the Rechtin-Lukasik period concerned phase-out of major institutional commitments somewhat akin to support of a laboratory. The list includes support for the university materials IDL's, termination of AGILE's field offices, phase-out of the Behavorial Science Cambridge Project, reorientation of support for artificial intelligence laboratories at Stanford and MIT, and divestiture of the ARPANET program. In each case, past commitments made change difficult and government-staffed ARPA laboratories would obviously have entailed even greater obligations.

Lukasik also was skeptical of laboratories organized around a given area of technology on the grounds that they tend artificially to limit a field. Laser technology, for example, is spread across a broad number of industrial and academic institutions, and to try to focus advanced research in the field in a central laboratory would, in Lukasik's view, be wasteful of these national assets. On this point, naturally, the Lukasik view is strongly endorsed by industry. Dr. Kantrowitz of AVCO, for instance, believes that the existence of government laboratories tends to restrict support for initiatives in private industry, given that they tend to have a first claim on funds and enjoy a protected status. Kantrowitz regards the ARPA principle of not owning in-house laboratories (which impacted on laser development especially in the Rechtin-Lukasik period) as perhaps <u>the</u> most important of ARPA's organizational virtues.[38]

As with the laboratory policy, Lukasik endorsed the executive agent concept. Agent performance varies across a broad spectrum and generalization is impossible. He is less critical than Betts, Ruina or Herzfeld and claims to have tried to make the agents "part of ARPA."

Contractor Critique of the New ARPA Style

Viewed from the perspective of many ARPA contractors the increased level of bureaucratic requirements, pressure for program transfer, pressure to eliminate forward funding and unobligated balances and so forth in the Rechtin-Lukasik periods is regarded as having had a decided negative impact on ARPA program effectiveness. A selection of comments by IPT contractors -- the IPT program having been substantially increased in both 6.1 and 6.2 funding in the Rechtin-Lukasik period -- is illustrative. One contractor, for example, notes a "steady drop in the general happiness level" of IPT personnel, with increased "struggling" over budgets, scope of work, and so forth. He notes decreased flexibility and authority for the IPT Office Director to make timely decisions and feels that this decrease in authority is related to ARPA's new management approach.[39] Another contractor ventured that ARPA support had taken a turn for the worse "in the last five or six years" with requirements for constant justification and rejustification, program plan drafting, etc. being a major irritant. This individual attributes earlier IPT successes to the fact that the ARPA staff was "constantly on the scene and we could discuss things as scientists as well as administrators," and he asserts that "that's one of the things that's breaking down now." He speaks of "a general break-down in confidence all along the line, which finally ended up making us waste almost a solid year of writing proposal after proposal of what we were going to do six months from now, a year from now, a year and a half from now, when we were working on techniques that we correctly believed would take four or five years to bear fruit...."[40] Another contractor faults the modern ARPA for beginning to over-structure projects, through pressing for more and more detailed work statements. He argues that this "gives relatively little opportunity for new ideas to come along" and states that highly structured projects are all right if what you want is "cheap coolie work, but that's not what ARPA wants out of us. Invention-to-order is quite difficult."[41] A fourth individual indicated that ARPA had become "bogged down ... they have these programs that have just gone on and on, more or less. They've changed a little bit, but not really significantly, instead of just really chopping some off and starting afresh with the new kids with the bright idea.... I still feel that I'm roughly the right age [for the ARPA group] ... and it's fifteen years later."[42] The erosion in ARPA's total budget and the elimination of the margin or "looseness" that enabled it previously to be able to "find some money" to support a bright new idea, quickly, parallels these views. As one observer puts it, it is "easier to get \$5 million two years from now, than \$50,000 now."[43]

All of these contractors, each from a different organization, give ARPA high praise for its record in the information processing field, including many aspects of the current program. In particular, they still contrast ARPA very favorably with other government funding sources, notably the NSF. A pervasive atmosphere of disillusionment, was however, unmistakeable (and

not limited to IPT's area of R&D) and appeared to focus on a perceived lack of flexibility and innovativeness and, above all, the loss of a paramount focus on supporting high quality research on the technological frontiers. Ever increasing bureaucratic requirements tended to be seen as betraying a lack of faith in the importance and relevance of the work performed and sometimes even the motivations of the performers.

Thus, while the more cautious and bureaucratic approach of the ARPA of the early 1970's may have been necessary, given the Defense, Congressional and general R&D environments, ARPA has clearly paid a price for it. That price appears to be cast in terms of some erosion of ARPA's unique commitment to underwriting advanced research on its technological merits, be those merits general quality of research, importance to science or the significance of its implications to the national defense.

The New ARPA Directive

On March 23, 1972, a new Department of Defense directive was issued which superseded the long-standing December 1959 ARPA Charter and established ARPA as a separate Defense Agency.[44] Formally renamed the Defense Advanced Research Projects Agency (or DARPA), the main impact of the change was to separate ARPA administratively from OSD/DDR&E and return the Agency to the "direction, authority and control of the Secretary of Defense," i.e., to restore the direct relationship that had been lost when the December 1959 directive was issued. The new DOD Directive, however, provided that "staff supervision of DARPA for the Secretary of Defense will be exercised by the Director of Defense Research and Engineering (DDR&E), who will provide scientific and technical policy direction for DARPA activities." There were no significant changes in the functions assigned to ARPA and much of the wording of the earlier Directive remained intact. The new Directive did discontinue the requirement for formal written project assignments to ARPA from the DDR&E, but the latter continues to review and approve the ARPA program.

The new status appears to be regarded as relatively insignificant by nearly everyone familiar with the change. It seems to have been triggered primarily by interest in freeing-up OSD personnel billets and saving some OSD Operations and Maintenance (O&M) funds. These purposes were accomplished simply by removing ARPA from its original position within OSD and declaring it a "Defense Agency." By 1972, of course, a whole family of these agencies had sprung up and including ARPA among them was logical. That the change in ARPA's status was not regarded as especially important is partially illustrated by the fact that the new name, and the acronym DARPA, never really caught on, and the old designations remain in use except for formal letterheads and citations. As one senior ARPA official described the new directive: "All of us realize that despite what the charter says, we really are [still] part of DDR&E."[45]

At the time that the change in directives was made, the new charter was, however, regarded as having some potential effects on ARPA's future way of doing business. On the one hand, the resurrection of a direct relationship with the Secretary was felt to open possibilities for greater direction from this source and hence somewhat greater independence from DDR&E. On the other hand, there were some fears that by separating ARPA from OSD, the DDR&E would come to regard ARPA as a less "special" organization and would again begin to review ARPA programs in greater detail. That is, there was concern that there might be less resolution of issues on the ARPA Director-DDR&E level and additional "nit-picking" review from DDR&E staff.

Neither of these predictions appears to have come to pass. The DDR&E remains the controlling force for the ARPA program, but continues to give the ARPA Director considerable latitude to shape it. Whether this will continue to be the case in the future is unpredictable. Theoretically, at least, the ARPA Director and the Secretary could establish reasonably direct lines of communication. The 1972 charter changes certainly suggest that ARPA is no longer in danger of abolition and has strengthened its position as a continuing part of the DOD bureaucratic landscape.

PROGRAMS IN THE LUKASIK PERIOD

Dr. Lukasik's tenure as ARPA Director began with a continuation of the extensive program and office restructuring of the Rechtin period. Midway through his period as Director, however, this process began to slacken and relative stability gradually returned to the organization. As of about mid-1973, the new ARPA organization consisted of a Strategic Technology office responsible for about $70 million in programs; a Tactical Technology office funded at about $35 million; a Nuclear Monitoring Research office with a budget over $20 million; an Information Processing Technology office covering over $35 million in programs; a Materials Science office funded at about $20 million; and a Human Resources Research office with about a $9 million budget. There was a small additional budget for technical studies and for project management support. This is merely an approximate picture of the mid-1973 budget, but reflects the general program balance reached under Dr. Lukasik's leadership. In the following months, the principal changes were growth in the Tactical Technology office and the addition of a small Technology Assessments office.

Prior to describing some of the features and activities of these offices, it is worth repeating that Dr. Lukasik gradually separated the "program elements" as presented in Congressional budget submissions from a direct one to one relationship with ARPA's internal office structure. As a result, discussion of the ARPA program is a bit more complicated than in previous chapters. The change came about partially because of the development of "exploratory development" tasks in offices which were formally funded

entirely through "research" funds. Since "research" and "exploratory development" (coded 6.1 and 6.2, respectively) are separately presented to Congress in DOD-wide budgets, the formal recognition that such hardware and systems development efforts as ILLIAC-IV and ARPANET were "exploratory development" activities required the creation of new program element categories. Thus the Information Processing Techniques office came to contain two program elements: "information processing techniques" (6.1) and "distributed information systems" (6.2); the Human Resources Research office similarly came to include "human resources research" (6.1) and "training, forecasting and decision technology" (6.2).*

In addition to the differences between program elements and ARPA offices, Dr. Lukasik also in some cases assigned management responsibility to one office for parts of a program element under the primary jurisdiction of another office, and experimented with cross office management techniques. This was done partially as a mechanism to ensure unified control over related work in separate offices pending formal consolidation (as in the area of underseas warfare, now largely consolidated under Tactical Technology); partially to fit work to existing staff capabilities; and partially to avoid the appearance of sudden shifts in the work effort. Given the turmoil in the ARPA work effort presented to Congress in past years, Lukasik preferred to change the scope of program elements slowly in order to emphasize stability, and ARPA's changes in internal organization of the work effort thus tended to move ahead of formal presentations about them. In this context it should be stated that there is nothing unusual in a Federal agency's budget categories not corresponding directly to internal office organization, and in fact this is probably the more common case.

The most striking example of this approach in the ARPA of the 1970's is ARPA's gradual entry into the undersea warfare area, long a private preserve of the Navy. Rechtin, Lukasik, Mann and others worked hard at making this penetration and consider it a major achievement. The research has been divided among several ARPA offices, e.g., STO, TTO, Advanced Sensors, and Nuclear Monitoring Research, according to Lukasik's new organizational precepts, and is difficult to summarize.

There has been periodic speculation over the years as to why ARPA was not asked to play the same role in antisubmarine warfare (ASW) R&D that it played in ballistic missile defense R&D. In part, this was due to a widely accepted belief that the oceans were inpenetrable, thus giving the offense a major advantage. It also reflected the unique position of the Navy as both the offensive and defensive user of the oceans. In the

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* To be more precise, the 6.1 portions of the materials sciences, human resources, and information processing programs were formally presented as sub-elements of "Defense Research Sciences," which encompassed all of the Agency's basic and applied research, or 6.1 work, as formally submitted to Congress.

DEFENDER's open-ended charter in underwater R&D, but is offering an interesting test case in this instance of the value of closely coordinated R&D in an area of deep single Service interest. The possibility of future differences of opinion, of course, is not negligible. The outcome of this experiment undoubtedly will have an important influence on ARPA's future.

The extended example above is only the most prominent of many contemporary ARPA efforts in which the ARPA program is difficult to delineate because of both increased dispersal of program elements within ARPA and more subtle relationships with Service programs. The summary of Lukasik period programs should therefore be read with an appreciation that many nuances of program structure are necessarily omitted. In addition, we have not attempted to assess ongoing projects in substantial detail, as historical perspective on their importance is as yet impossible. For purposes of succinctly summarizing the ARPA program effort of the early 1970's, the following description is organized around the ARPA office structure, as in previous sections.

Strategic Technology Office

ARPA's Strategic Technology Office, the successor to Project DEFENDER, had begun to take on its own character and shape by the time of Dr. Rechtin's departure. Some of the miscellaneous projects held over from the former effort were phased out, some reoriented and others given new priority and support. Additional new initiatives were generated as budget flexibility arose from the evolution of older programs past their peak funding requirements.

By 1971, the Strategic Technology Office (or STO) was described as follows:[51]

> The Strategic Technology Office is concerned with a broad range of science and technology directly applicable to the maintenance of the US strategic deterrence: in particular, the technological balance between strategic offense and defense, and to the technical problems of strategic surveillance and early warning.

The centerpiece of STO in terms of visibility and "popular appeal" was, by this time, clearly the high energy laser program. While, as noted in previous chapters, ARPA had had an interest in lasers for potential weapons applications tracing back nearly to the origins of the technology and had supported major breakthroughs in high energy technology in the mid-to-late 1960's, the exposure given the effort increased dramatically in the 1970's. Part of this increased exposure derived from downgrading the classification of the program (originally a special access program) and part from the

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> broad purview of potential Defense applications, they want an ARPA that ... [T]ackles the tough, the unique, the unconventional and is not afraid of failure when the prospect of a major payoff in national security is great....
> There will be failures. The purpose of R&D is to determine what will work, what won't, and why. When the Congress reviews the balance sheet at the end of each year, I invite them to examine the failures as well as the successes. But please look at the balance at the bottom. As Director, I believe that I can guarantee to you that the bottom line will show a clear gain in future national security ... a fair return for the public investment.

There clearly are overtones of Roy Johnson, Robert Sproull and Charles Herzfeld in that portrayal of ARPA's role, but also a new emphasis in the concept of a "fair return" on the ARPA investment. Once again a change at the helm has brought a new perspective to the Agency, and another chapter in the history of ARPA has begun.